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III. *A Letter of Dr Wallis to Captain Edmund Halley; concerning the Captains Map of Magnetick Variations; and some other things relating to the Magnet.*

Oxford, May 23. 1702.

S. I R,

I Sent you a Letter about three weeks since, (which, I hope you received,) with my hearty Thanks for the Present you had then sent me; your Map of the *Magnetick Variations.*

I look upon the thing as an Excellent Design, and very Instructive; well Contrived, and well Executed; And which, I think, was never undertaken by any, before you.

For a true Natural *History* of matter of Fact, is certainly the surest Foundation on which to ground a Physical *Hypothesis*, to explain the *Causes*.

I am very well pleased to see, upon the whole, so promising a Prospect, as (to me) this seems to be.

It fixeth the business of Magnetick Variation (in these Seas) for the *Present Time*. If like Observations had been made in former Ages, and transmitted to us, it would have been of great use. But it is now too late to wish for that.

If like Observations shall be made for the Future, from time to time, and Recorded; whereby it may appear, at what Rate the Variation Varies; it will afford a great In-light into the Magnetick Doctrine, of which we are so much in the dark.

I hope

I hope you intend to publish a *Discourse*, in pursuance of that *Map*, which I shall be glad to see : Expecting to find, therein, divers considerable Remarks, by you observed in the Southern Seas ; where (perhaps) never any had been, so far Southward, as you have been.

The Doctrine of the *Magnet*, hath been mostly improved at *Gresham College*, (or by those related thereto, and there conversant,) for an Age or two last past ; as *Blagrave*, *Gunter*, *Gellibrand*, *Gilbert*, *Norwood*, *Wright*, *Brigs*, *Foster*, &c.. and (of late) by *yourself*. If I have mistaken some Names, or misplaced them, or omitted others ; you will be able to rectifie it.

I have given some Intimation of it (but very imperfectly) in a Letter of mine, inserted in the *Transactions* for the Month of *December 1701*. where (beside divers Literal Faults) they have unhappily mis-printed 1635, instead of 1625.

For it was about the beginning of the Reign of King *Charles the First*, that Mr *Gellibrand* (if I have not been mis-informed) caused the Great Concave *Dial* to be erected in the *Privy Garden at White-hall*, (which, I think, is yet remaining;) with great care to fix a true *Meridian-Line*; and with a large *Magnetick Needle*, shewing its *Variation*, from that *Meridian*, from time to time.

I think it were not amiss, if exact Observation were now made, whether the *Meridian* be, Now, just the same as it was Then. • For it is very possible, that the *Pole* of the Earth, may, in time, suffer some little Variation (which may not readily be discerned,) which may cause an Alteration of the *Meridian-Line*. And this, if so, will be more discernible Nearer the *Pole*, than Farther off.

And though such Provision (as was but now said) were made at *White-hall*, for observing the Needles Variation from the true North ; and, though (no doubt) notice have been given many times (there and elsewhere) what the Variation hath been at such times : Yet, I doubt, no

Register hath been kept of such Observations ; whence we might form a Scheme, how such Variations do proceed from time to time.

It hath been observed also, of what they call the *Dipping Needle* ; that, (beside the *Horizontal* Direction toward the North,) it hath also a Direction of *Altitude*, above and below the Horizon, if balanced on an Horizontal Axis : Pointing as it were with its Northern end (in our Climate) to some Point within the Body of the Earth. Whether or no this Direction do Vary (from time to time) as doth that of its Horizontal Position Northward ; I cannot tell : nor do I know, whether or no it hath been yet observed. Nor, whether or no the Southern End, in other parts of the World, do *Dip* ; as the Northern End doth with us. All which things deserve serious Consideration.

I could wish, that you would take some pains, (for I know not who can do it better,) by yourself, or whom else you shall think fit to associate, to collect, and give us a brief History, of what hath been done in this kind, (how, when, and by whom;) and by what Steps the Doctrine of the *Magnet* hath been gradually promoted : For it is pity the Memory of it should be lost. And perhaps it may be the last Request I may live to beg of you, (being now at the age of 86;) And it is for the Publick, and not for my self.

Or, if it be too great a task for you to undertake at present, (who have your hands full of other weighty business;) I wish the Royal Society would seriously recommend it to the care of some other fit person, of their Members, who may be Able and Willing to undertake it : As a thing that would be welcome to the Inquisitive World, would be an Honour to the Nation, to *Gresham-College* in particular, and, to the *Royal Society*.

I have (in the Letter above mentioned) given my Conjecture, that the *Mariners Compass* (of such prodigious use in Navigation) was Originally an *English* Invention. Not

Not only, because *England* was, at that time, as famous for Navigation as any Nation that I know, (for the *Holland* Sea-trade was not then in Being, nor for a long time after.) But even from the Name of *Mariners Compass*, (for what, in *Latin*, is called *Circulus Nauticus*.) For the word *Compass*, is an ancient *English* word, for what we otherwise call (by a *French* name) a *Circle*.

And I am sure that, within my Memory, (in the place where I was Born and Bred,) it was wont to be commonly so called, (however, of later times, the word *Circle* is more in use.) And, if we consult *Minsheu's Dictionary*, we shall find, that he takes *Circle*, and *Compass*, indifferently to signify the same with *Circulus*.

And hence it is that *Circinus*, is, in *English*, called a *Compass*, (or a pair of *Compasses*,) as being the Instrument by which we describe a *Compass*, or *Circle*.

Now I do not know, that the word *Compass* then was; (or now is,) in any other language, so used for a *Circle indefinitely*, or for any other *Circle* than the *Circulus Nauticus*. But now, in all Languages, (*French*, *Italian*, *German*, &c.) the *Circulus Nauticus* hath the Name of *Compass*, (or somewhat analogous,) *compafs*, *compasso*, *zee-kompas*, &c. Which Name, I guess, together with the *Art*, they borrowed from *England*.

I might urge the same, from another Name, *Bossole*, *Bossola*, &c. For, as *Circulus Nauticus* is the *Mariners Compass*; so *Pyxis Nautica* is the *Mariners Box*, (for the English *Box* is from the Latin *Pyxis*;) And *Pyxidula* (as a Diminutive from *Pyxis*) must be *Boxel* (or some word like it,) which easily passeth into the French *Buxole*, *Bouffole*; and the Italian *Bossola*, *Bouffola*, *Bossola*; which all seem to be from the English *Boxel* (*Pyxidala*) a little *Box*; softening the sound of the letter *x* in *ff*; as in *Aleffandro* for *Alessandro*.

All which, though it be not a direct Demonstration (in the silence of History;) is at least a Probable *Conjecture*, and

and a Plausible Pretence to the Invention (till a better claim do appear.) For, in the case of *New Inventions*, when they come abroad, they commonly take their *Names*, from whence the Invention itself is taken.

And where Inventions creep in by degrees, it must not be thought strange, if it be not easie to say, who is the *First Inventer*.

In the present case ; He who first observed (I know not by what Accident) that the *Magnet* hath a *Polarity*, or Inclination Northward, made the *First Step* towards this Invention. This (I think) was at first wont to be shewed, by putting a Magnet into a little Boat, swimming on Water, when it was observed, that this Magnet would of it self so steer this little Boat, as that a certain Point in the Magnet would (if not hindered) turn toward the North. Which Point was thereupon called the Magnets *North Pole*.

He that afterward observed, that this Verticity, or Polarity, was communicable to a piece of Iron or Steel, rubbed on a Magnet, added a further step toward the busines in hand.

And he who contrived a way to set a Needle or piece of Steel (so touched) on a sharp Pin, so as (in the Air) to move Horizontally thereon, so as (of itself) to find out the North, and Point toward it, as (before) the Swimming Magnet (in its Boat) had done on the Water ; had now discovered a New Experiment, in Natural Philosophy, ver-ry surprizing.

But this cannot yet be called *Circulus Nauticus* (or the *Mariners Compass*,) till they had further contrived a way, how to put a Needle (thus poised) into a Box, with a *Compass* or Circle round it ; so divided as to denote the Azimuthal Points of the Horizon, (or, as they be now called, the *Points of the Compass* ;) and so commodiously to fix this Box (so prepared) to the Ship, as thereby to instruct the Mariner (or Steers-man) toward what Point of the *Compass* the Ship moved ; that (by the help of the Rudder, he might put it into such a course, as was proper

per for his Voyage. And it was now indeed *Pyxis Nautica* or *Circulus Nauticus*, (the *Mariners Box* or *Compass*,) but not till Then. And he who first contrived this Application, did compleat this Invention of *Circulus Nauticus*. But all those antecedent Discoveries were steps towards it, and Parts of the Invention.

Now it is not likely, that all these Discoveries were made at once (by the same Man, at the same Time,) but Successively ; by the joint Advice of divers Inquisitive Men, and in a considerable tract of Time ; yet all perhaps of the same Nation, and (probably) the *English*.

But, whoever gave the first Hint of this Invention; certain it is, that the great *Improvements* of the Magnetick Doctrine are due to the *English*; and chiefly to those about *London*, and *Gresham-College*. And it is fit the Memory of it should be preserved.

The Case is much the same with that of *Printing*, which we cannot reasonably suppose to be invented all at once ; nor perhaps all by the same Man ; But rather, by the concurrent advice of divers, and in a considerable tract of time, before it come to that degree of Perfection, which we now call *Printing*.

It might be first observed, that the shape of a Letter, Figure or Picture, graved on Wood or Metal, might (with help of a convenient preparation of Oil, Ink, or coloured Liquor) be stamped on Paper. And, if once, then as oft as you please.

And, if by stamping the Print on Paper, then (as well) by due application of the Paper to the Print, thus prepared.

And, if one, then (by the same reason) to two or more (if fitly conjoined) and even to a whole Page at once : and, of that, as many Copies as we please.

But (this being admitted) it remains further, to be contrived, how all these Prints or Stamps (for a whole Page) shall be so composed into one Frame, that the Paper may be applied to all at once.

It is then to be considered further, what kind of *Ink* (or somewhat instead of *Ink*) is to be applyed to the Face of the Letters thus composed. For common Writing *Ink* will not serve the turn.

Then, How the Paper shall be applyed (with an Equal pressure, and sufficient) so as to take off just so much of that *Ink*, as represents the Face of those Letters, and no more.

And, after all this, it must be further contrived, How to erect such a Structure, as what we now call a *Printing-Press*: and, How to manage it, so as to answer all these Exigences. For, till
all

all this be done, we are not arrived at what we call *Printing*. But all those previous Contrivances, must be owned as *Parts of the Invention*.

And, in the *Magnetick Doctrine* likewise. And, to those *previous Discoveries*, must be added, the *Subsequent Improvements* of Magnetick Knowledge, since the first *use* of the *Mariners Compass*. But of this enough.

I understand, you are engaged also in the business of the *Tides*, and the *Soundings* in our *English Seas* (and to very good purpose,) as well as the *Magnetick Variations*. Of which the one may possibly be subservient to the other.

You may perhaps think fit, (in order thereunto, / to cast your Eye on my Hypothesis, *De Aëstu Maris*. Which, through a short Essay, and published long since, (and but from a moderate knowledge of the History of Tides;) contains (I think) much of Truth in it; and is capable of being Polished, by those who are better acquainted with the History of Tides, than I pretend to be. For I look upon these *Hypotheses* as highly probable, which do naturally follow from the general *Laws of Motion* duly considered. And I cannot but think, that, as well the *Course* and *Variation of Tides*; as the *Breezes* and *Trade-Winds* in several parts of the World; and the *Currents* on several Coasts, with their *Annual Vicissitudes* at several times of the year; do all depend, in great measure, on the *Earth's Motion*, with that of the *Moon* (its Attendant,) and the *Compound Motion* of Both, with their *Common Center of Gravity*.

But I would not prejudice your speculations; whomay have reason to suspect some *Interrine Motion* within the Body of the Earth, of which we are not well aware.

SIR,

Yours to serve you,

John Wallis,